

## CLAIMS

1. A substrate material for X-ray optical components for X-rays of wavelength  $\lambda_R$ , comprising a glass ceramic material with a glass phase made of amorphous material and a crystal phase, comprising microcrystallites, with the amorphous material having a positive thermal expansion and the microcrystallites having a negative thermal expansion and the stoichiometric ratio of crystal to glass phase being set in such a way that the amount of the thermal expansion  $\alpha$  of the glass ceramic material is in a temperature range of  $20^\circ\text{C}$  to  $100^\circ\text{C} < 5 \times 10^{-6} \text{ K}^{-1}$ , especially  $< 1 \times 10^{-6} \text{ K}^{-1}$ , with the mean size of the microcrystallites being  $< 4 \lambda_R$ , especially  $< 2 \lambda_R$ , preferably  $< \lambda_R$ , more preferably  $< 2/3 \lambda_R$ , especially  $< \lambda_R/2$ , characterized in that the substrate material, following a surface treatment, shows a roughness in the high spatial frequency (HSFR) region of  $< \lambda_R/30$  rms, preferably  $< \lambda_R/50$  rms, especially preferably  $< \lambda_R/100$  rms.  
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2. A substrate material as claimed in claim 1, characterized in that the wavelength of the X-rays is in the range of  $\lambda_R$  of 10 to 30 nm.  
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3. A substrate material as claimed in one of the claims 1 to 2, characterized in that after a surface treatment the defect in the low spatial frequency region is in the range of  $\lambda_R/50$  to  $\lambda_R/100$  rms.  
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4. A substrate material as claimed in one of the claims 1 to 3, characterized in that after a surface treatment the defect in the middle spatial frequency region (MSFR) is in the range of  $\lambda_R/50$  to  $\lambda_R/100$  rms.  
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5. A substrate material as claimed in one of the claims 1 to 4, characterized in that in the surface treatment of the substrate  
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material the surface of the X-ray optical component is superpolished at first and thereafter the surface is further processed by a beam processing method.

- 5        6. A substrate material as claimed in one of the claims 1 to 5, characterized in that the substrate material is a substrate material for a reticle mask for EUV lithography.
- 10        7. A substrate material as claimed in one of the claims 1 to 5, characterized in that the substrate material is a substrate material for a normal-incidence mirror, with a multilayer system with a plurality of layers with high reflectivity in the X-ray range in the case of non-grazing incidence being applied onto the substrate material.
- 15        8. A substrate material as claimed in claim 7, characterized in that the mirror has an aspherical shape.
- 20        9. A substrate material as claimed in claim 7 or 8, characterized in that to the substrate material there is applied a multilayer system comprising 40 to 200 layer pairs consisting of one of the following materials:  
Mo/Si  
Mo/Bi  
MoRu/Be.
- 25        10. An X-ray optical component, characterized in that it comprises a substrate material according to one of the claims 1 to 9.
- 30        11. An X-ray optical component as claimed in claim 10, characterized in that the X-ray optical component is a normal-incidence mirror or a grazing-incidence mirror.

12. An X-ray optical component as claimed in claim 10, characterized in that the X-ray optical component is a reticle mask.

13. A method for producing a substrate material for an X-ray optical component for X-rays of wavelength  $\lambda_R$ , with the substrate material being a glass ceramic material and the method comprising the following steps:

13.1 surface of the substrate material is superpolished until a high spatial frequency roughness (HSFR) of  $< \lambda_R/30$  rms, preferably  $< \lambda_R/50$  rms, even more preferably  $< \lambda_R/100$  rms, is achieved;

13.2 the surface is further processed with a beam processing method until the defect in the low spatial frequency region is  $\lambda_R/50 - \lambda_R/100$  rms and the defect in the middle spatial frequency region (MSFR) is  $\lambda_R/50 - \lambda_R/100$  rms, with the high spatial frequency roughness (HSFR) obtained being  $< \lambda_R/30$  rms, preferably  $< \lambda_R/50$  rms, even more preferably  $< \lambda_R/100$  rms.

14. The use of a substrate material for X-ray optical components as claimed in one of the claims 1 to 9 in an EUV projection system, comprising an illumination system and a projection lens system.

15. The use of a substrate material for X-ray optical components as claimed in one of the claims 1 to 9 in one of the following fields:  
X-ray microscopy;  
X-ray astronomy;  
X-ray spectroscopy.